Development of High Energy BROND Library up to 150 MeV

Evgeny V. Gai[1], Anatoly V. Ignatyuk[2], Vladimir V. Lunev[3], Yuri N. Shubin[4], Nikolay N. Titarenko[3]

[1] *Principal Scientist, IPPE, Obninsk*
[2] *Head of Theoretical Division, IPPE, Obninsk*
[3] *Senior Researcher, IPPE, Obninsk*
[4] *Head of Laboratory of Nuclear Theory, IPPE, Obninsk*

Investigations aimed at the development of neutron cross-section evaluations and creation of High Energy BROND library for actinides in the range up to 150 MeV are discussed. The complete data files for ^{232}Th, ^{238}U, ^{239}Pu, ^{240}Pu, ^{237}Np and ^{241}Am have been created at the IPPE during the last years.

The coupled-channel optical model has been used to calculate the neutron total, elastic, and reaction cross sections and the elastic scattering angular distributions. The parameters of the optical model have been determined on the basis of available experimental data including the recent precise measurements of the total cross sections for ^{232}Th and ^{238}U. The calculations based on these parameters describe consistently the available data on neutron and proton absorption cross sections in a wide energy range and enable to evaluate the total and elastic scattering cross sections for actinides with a higher accuracy than previous evaluations. Analysis of data has been performed both below and above 20 MeV neutron energy.

Evaluations of the fission cross sections, the secondary neutron multiplicities and spectra, as well as the charged particle production cross sections are performed in the frame of the statistical model that includes direct, preequilibrium and equilibrium mechanisms of nuclear reactions. For neutron energies above 20 MeV the evaluation of fission cross sections was obtained using statistical optimization with rational functions. Such approach allows us not only to provide the critical selection of experimental data, but also to determine uncertainties of evaluations together with the corresponding covariance matrix. The description of multiplicity and spectra of secondary neutrons was realized separately for the events with and without fission. The Kalbach parameterization of angular distributions has been used to describe the double-differential cross sections of emitted neutrons and charged particles in ENDF/B-VI format. The recently published experimental data have been used to estimate more precisely model parameters for charged particle production. The direct and pre-equilibrium pick-up and knock-out mechanisms were taken into account for the cluster emission.

The created files are intensively used now for the comparative analysis of developing accelerator-driven systems.

The results obtained were supported partially by the ISTC Project #1372.

Email: shubin@ippe.obninsk.ru